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Population density and biomass of the bivalves *Tellina mariae* and *Katelysia rhytiphora* from a seagrass bed in Western Port, Victoria*

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SUMMARY

Each month from March 1976 to March 1977, samples of the bivalves *Tellina mariae* and *Katelysia rhytiphora* were taken from an intertidal seagrass bed in Western Port, Victoria. *T. mariae* was the more abundant species and had a mean monthly population density of 48 individuals/m^2 and a mean monthly population biomass of 5.53 g dry fresh weight/m^2 *K. rhytiphora* had a mean monthly population density of 17 individuals/m^2 and a mean monthly biomass of 2.33 g dry flesh weight/m^2. The *Tellina* population was dominated by small individuals. In contrast, the *Katelysia* population was dominated by large individuals. Possible reasons for this difference in population structure are discussed.

INTRODUCTION

Tellina mariae, a surface deposit-feeder, and *Katelysia rhytiphora*, a suspension-feeder, are amongst the most common species of bivalves in Western Port (145°20'E, 38°20'S), a bay approximately 70 km south-east of Melbourne (Coleman *et al.*, 1978). Despite their being common, rather little is known about the biology of either species although Nielsen (1963) carried out some studies on the morphology, reproduction and parasites of *Katelysia* in Port Phillip Bay, which is adjacent to Western Port.

The present paper describes a study of the abundance and biomass of *Tellina mariae* and *Katelysia rhytiphora* from a seagrass bed in the north of Western Port.

MATERIALS AND METHODS

The general features of Western Port and the distribution of sediment types and aquatic vegetation throughout the Bay are described in Coleman *et al.* (1978). Each month from March 1976 to March 1977, samples were collected from an intertidal seagrass bed in the north of the bay (adjacent to station 1708, Coleman *et al.*, 1978: Fig. 2). The samples were

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taken at high tide from a small boat working in conjunction with a larger vessel whose radar was used to locate the sample site. At the site a sampling frame with an area of $0.05 m^2$ was thrown over the side of the boat. The area within the frame was excavated, by divers, to a depth of 30-40 cm and the sediment and seagrass placed in a bucket. Forty samples, the maximum number that could conveniently be handled in the time available, were randomly taken around the spot where the sampling frame first fell.

The samples were taken back to the larger vessel and washed through a 2 mm mesh sieve. *Tellina* and *Katelysia* were removed from the sieve, placed in aerated seawater for 18-24 hours to allow emptying of the gut, and then frozen. The residue from sieving was preserved in 5% neutral formalin.

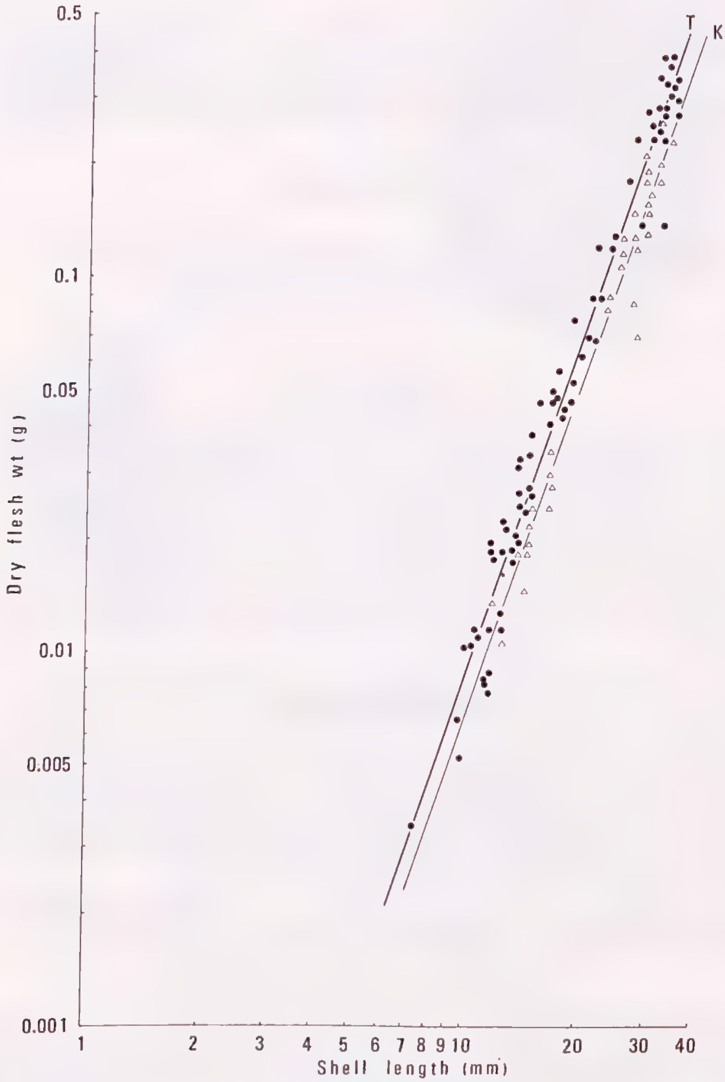

Figure 1. The relationship between shell length and dry tissue weight for *Tellina mariae* (●, regression line T; sample of April 1976) and *Katelysia rhytiphora* (△, regression line K; sample of December 1976).

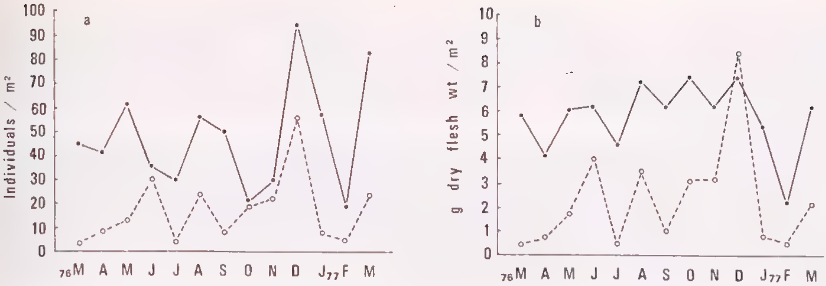

Figure 2. Monthly values for a, population density (individuals/m²) and b, population biomass (g dry weight/m²) for *Tellina mariae* (●————●) and *Katelysia rhytiphora* (o- - - - - - -o) from March 1976 to March 1977.

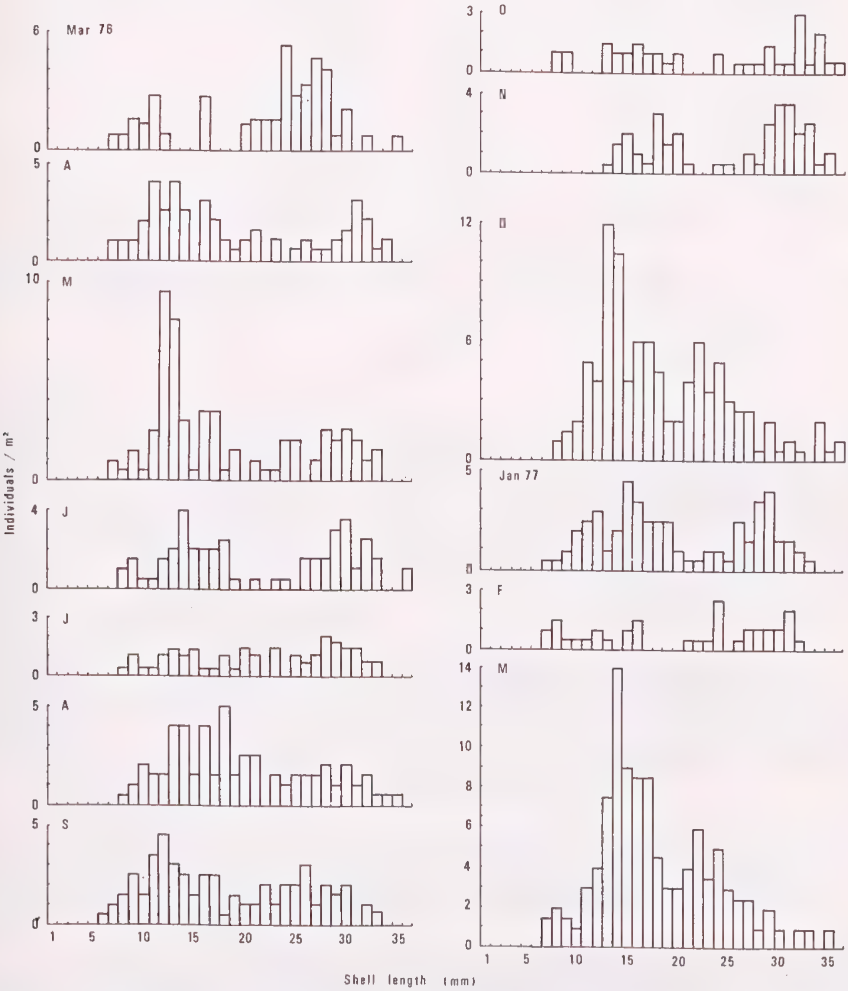

Figure 3. Size frequency histograms for *Tellina mariae* sampled from March 1976 to March 1977.

In the laboratory the shell length of each individual was measured to the nearest 0.01 mm with a micrometer. The soft parts of the animals were dried for one week at 90°C and dry weight determined. The preserved residue from sieving was sorted for individuals missed during earlier sieving. The length of each individual removed from the sieve-residue was measured.

For each month's sample of each species, the relationship between shell length and dry weight was determined. The dry weights of individuals removed from the sieve-residue were estimated from the calculated length-weight relationships. Population density (individuals/m²) and biomass (g dry flesh weight/m²) were calculated. Monthly changes in the flesh weights of standard length individuals (10, 15, 20, 25, 30 mm shell lengths) were estimated from the length-weight relationships.

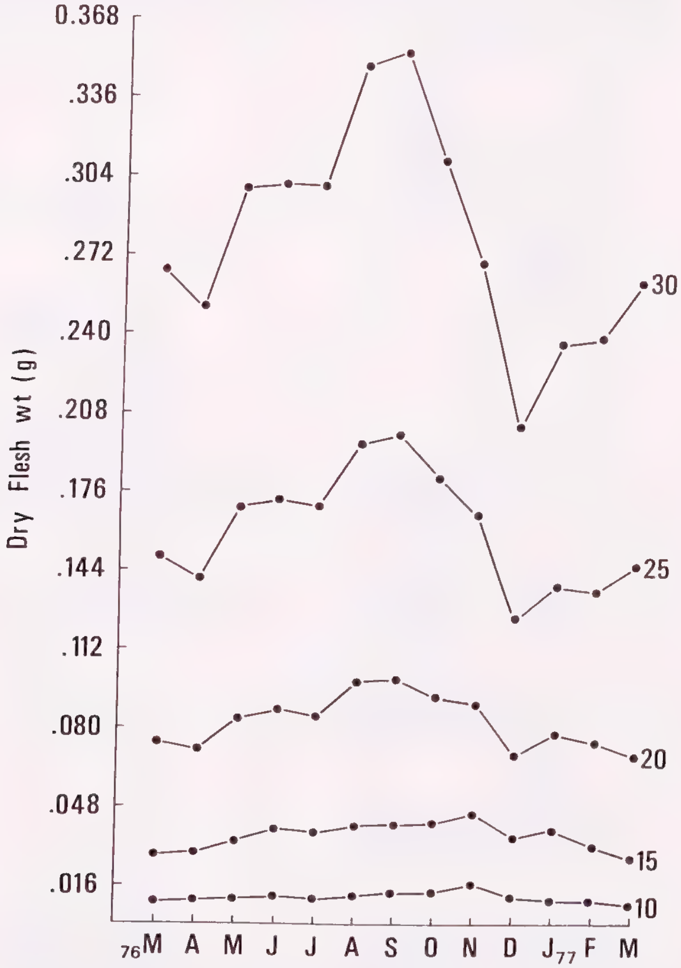

Figure 4. Monthly changes in the flesh weights of *Tellina mariae* of 10, 15, 20, 25 and 30 mm shell length. Weights have been estimated from the length/weight relationships calculated for each month's sample from March 1976 to March 1977.

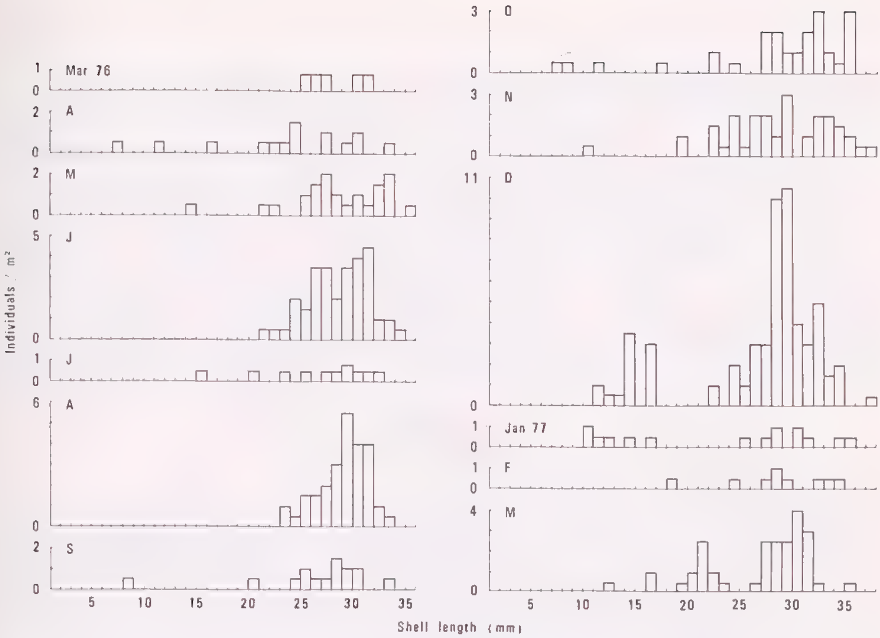

Figure 5. Size frequency histrograms for *Katelysia rhytiphora* sampled from March 1976 to March 1977.

RESULTS

Tellina mariae

The relationship between shell length and dry weight is linear when plotted on logarithmic scales (Fig. 1), and there is no inflexion associated with sexual maturity. Monthly values for *b*, the slope of the calculated regression line, ranged from 2.59 to 3.23 with a mean value of 2.98. Values for *b* were not compared for statistically significant differences. Significant differences in *b* have been reported in other studies of bivalves. However, it is not clear whether such differences are of biological significance, being related to differences in the state of gonad development for example (Barybina and Sanina, 1975), or result from differences in the size ranges of individuals collected in different samples (Hughes, 1970).

Population density ranged from 19 to 94 individuals/m^2 (Fig. 2a) with a mean and standard deviation of 48 + 23. Biomass (g dry flesh weight/m^2) ranged from 2.24 to 7.41 (Fig. 2b) with a mean and standard deviation of 5.53 + 1.41. Variations in density and biomass were cyclical, peaks occurring at approximately three-monthly intervals (Fig. 2). Particularly large numbers of small *Tellina* were found in March and December 1976, and in March 1977 (Fig. 3).

In all months an extensive size range of individuals was present, with smaller individuals being predominant for most of the year (Fig. 3). Size frequency histograms give no clear indication of progression of modes, and variations in the numbers of individuals in the monthly samples are such that mortality rates cannot be calculated.

The pattern of monthly changes in weight varies according to the size of the individual (Fig. 4). For individuals of up to around 15 mm shell length, weight increased gradually until November 1976 and thereafter declined. For individuals of around 20 mm shell length, weight changes were more marked than for smaller individuals and maximum weight was reached in September 1976. For individuals of around 25 mm shell length and

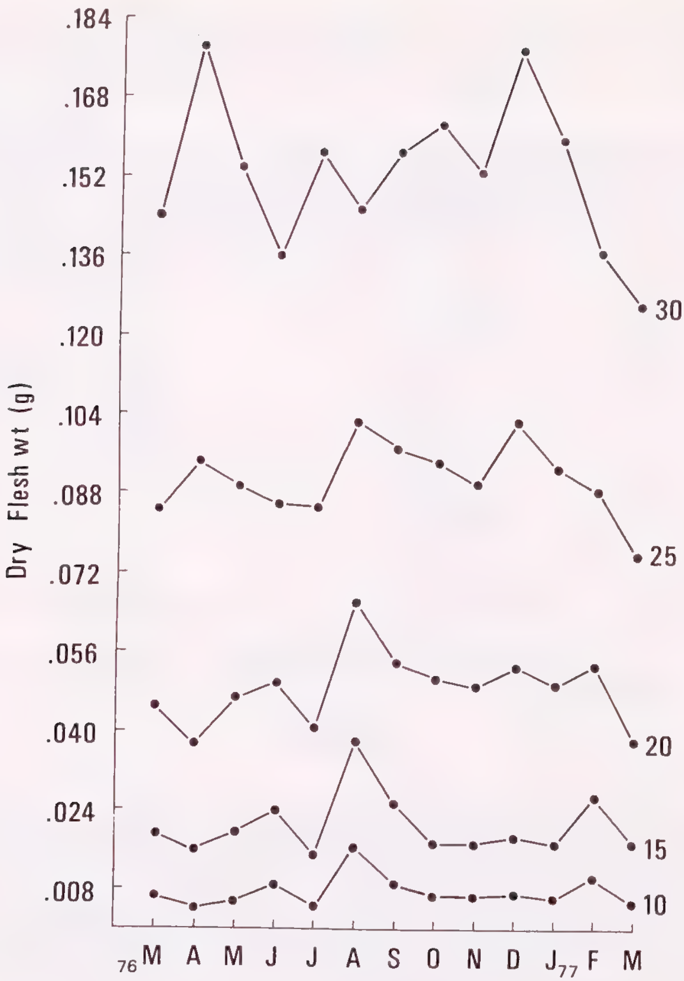

Figure 6. Monthly changes in flesh weights of *Katelysia rhytiphora* of 10, 15, 20, 25 and 30 mm shell length. Weights have been estimated from the length/weight relationships calculated for each month's sample from March 1976 to March 1977).

upwards, weight increased until September 1976, showed a massive decline until December 1976 and then increased again.

Katelysia rhytiphora

In *Katelysia,* as in *Tellina,* the relationship between $\log^{10}$ shell length and $\log^{10}$ dry weight is linear with no inflection due to sexual maturity (Fig. 2). Monthly *b* values ranged from 1.96 to 3.48 with a mean of 2.6. They were not compared for statistically significant differences.

Population density ranged from 3 to 56 individuals/m^2 (Fig. 2a) with a mean and standard deviation of 17 + 15. Biomass (g dry flesh weight/m^2) ranged from 0.35 to 8.45 (Fig. 2b) with a mean and standard deviation of 2.33 + 2.26. As for *Tellina,* there is some indication of cyclic variation in abundance and biomass. Except for the sample of December 1976, the biomass of *Katelysia* was less than that of *Tellina.* In all months *Katelysia* was less abundant than *Tellina.*

In all months a restricted size range of individuals was present, and the population was dominated by large individuals (Fig. 5). Variations in the number (Fig. 2) and size distributions (Fig. 5) of the individuals in the monthly samples are such that growth and mortality rates cannot be calculated.

No clear inferences can be drawn concerning relationships between shell length and monthly changes in weight. In all months individuals of 20 mm shell length or less were absent from, or at best poorly represented in, the samples. Thus, while it is possible to estimate weight changes for smaller individuals (Fig. 6), little reliance can be put on these estimates because they are drawn from length-weight relationships calculated from a limited size range of larger individuals. In large individuals, of around 24 mm shell length and greater, there are periods of increase and decrease in weight. However, the weight changes shown by large *Katelysia* are not a straightforward or as great as those shown by large *Tellina.*

DISCUSSION

Previous faunal survey work (Coleman *et al.*, 1978) has shown that *Tellina mariae* and *Katelysia rhytiphora* have similar distributions throughout Western Port. The present study has provided quantitative data on the population density and biomass of these species within a more sharply defined area, that of a seagrass bed on the northern intertidal flats. The present study, like the previous survey work, indicates *Tellina* to be the more abundant species, and also indicates that *Tellina* provides the greater biomass.

In Victoria, several marine invertebrate species are known to be reproductively active between August and December (as well as at other times of the year). The bivalve *Neotrigonia margaritacea* and the crustaceans *Callianassa arenosa* and *C. australiensis* in Western Port are reproductive during this period (Wellington, 1966; Coleman, 1981), as are the bivalves *Katelysia rhytiphora, Katelysia scalarina* and *Mytilus edulis* in Port Phillip, a bay adjacent to Western Port (Nielsen, 1963; Hickmann, unpublished). From the present work, changes in size frequency distributions and in flesh weight suggest that *Tellina mariae* is also reproductive during these months. The abundance of small *Tellina* in May and December 1976 and in March 1977 indicates spawning in the preceding months, and spawning probably explains the marked weight loss in large *Tellina* between September and December 1976. Weight loss after September was only slight in individuals of 20 mm shell length, suggesting that this is about the size at which the species becomes reproductive.

Katelysia rhytiphora samples did not provide such clear evidence for reproductive behaviour. Few small *Katelysia* were found at any time, and although the greatest number of young was found in December 1976, the greatest weight loss occurred between December 1976 and March 1977. Even between December 1976 and March 1977, the weight loss by *Katelysia* was not as great as that shown by *Tellina* during its period of maximum weight loss. Nielsen (1963) found that reproductive individuals are present in *Katelysia* populations for much, if not all, of the year. It may be that in *Katelysia* populations, spawning is not as synchronous as in *Tellina,* hence changes in mean weight are not as marked.

A knowledge of the mean annual biomasses of *Tellina mariae* and *Katelysia rhytiphora* allows estimates to be made of the production and longevity of these species. Such estimates are possible because of data on the P:B ratios of other bivalves and because of the relationships which have been shown to exist between P:B ratios and life span.

Robertson (1979) reviewed much of the recent literature on the production of marine invertebrates. From the values given in Robertson, supplemented by those in Warwick *et al.* (1978), the mean value for the P:B ratio for tellinid bivalves is found to be 1.72 and that for venerid bivalves is 0.94. Multiplying the mean monthly biomasses of *T. mariae* and *K.*

rhytiphora by 1.72 and 0.94 respectively gives production estimates (as g dry flesh weight/m²/yr) of 9.51 and 2.44 for these bivalves.

Robertson (1979) also demonstrated a relationship between the P:B ratio and the longevity of marine invertebrates. For bivalves, this relationship is expressed by the equation $P:B = 0.6207 - .7826 \log_{10} L$, where L is the life span in years. By substituting into the equation a value of 1.72, as the average P:B ratio of tellinid bivalves, the life span of *T. mariae* may be estimated as a little over three years. Similarly, by substituting a value of 0.94, the life span of *K. rhytiphora* may be estimated to be about seven years.

An inverse relationship between production and the life span of molluscs was also found by Zaika (1973). The measure of production used was the mean daily value for specific production, C, calculated by dividing the annual production by the mean annual biomass and by 365.

From the data in Zaika (1973) it may be shown that $C = 0.0166 - 0.0166 \log_{10} L$, where C is the mean daily value for specific production and L is the life span in years. Using the estimated production, of 9.51 g dry flesh wt/m²/yr, for *T. mariae,* C may be calculated as 0.0047 and life span as a little over five years. From the estimated production, of 2.44 g dry flesh wt/m²/yr, for *K. rhytiphora.* C is found to be 0.0026 and the life span about seven years.

The present estimates of the production and life span of *T. mariae* and *K. rhytiphora* are only tentative because they are derived largely from information in the literature. There are no other data on these species with which the present estimates may be compared, although different populations of the same species might be expected to differ in production, P:B ratios and longevity, all of which may be affected by environmental conditions. Most comparable with the present estimates are those for *Tellina deltoidalis* and *Katelysia scalarina* (Hodgkin, 1978; Robertson, 1979). Robertson (1979) estimated a life span of 4+ years, a production of 2.35 g dry flesh wt/m²yr, and a P:B ratio of 1.42 for a population of *T. deltoidalis* in Western Port, and Hodgkin (1978) reports a life span of 3-5 years for *K. scalarina* in the Blackwood River estuary, Western Australia.

A lower P:B ratio for *Katelysia* than for *Tellina* has been assumed on the basis of information in the literature. A lower P:B ratio would also be expected for *Katelysia* because of the population structure of this species. Populations which are dominated by large individuals are likely to have low P:B ratios because large individuals contribute more to biomass than to production (Robertson, 1979).

The lack of small *Katelysia rhytiphora* could indicate that, prior to and during the study period, conditions were unfavourable for reproduction, or that young and adults have different habitat preferences. However, the abundance of young *Tellina* suggests that conditions cannot have been generally unfavourable for bivalve reproduction, and young and adults of *K. rhytiphora* have been found together both in Western Port and in Western Australia (Roberts, unpublished). Possibly the lack of small individuals is related to the life history strategy of *Katelysia;* it appears to be a consistent feature of this species and has also been reported for living populations in Western Australia (Roberts, unpublished) and subfossil populations in Western Port (Wilke, 1977).

Seed and Brown (1975) described a population of the bivalve *Modiolus modiolus* which was dominated by large individuals, in which the proportion of ripe individuals was always high and in which there was little evidence of spawned individuals. They interpreted these characteristics as showing slow but continual recruitment to the population, and a high survival rate amongst individuals once they had grown past a critical size. The similarities in population structure and reproductive behaviour suggest that *Katelysia rhytiphora* has a similar life history to that of the *Modiolus* described by Seed and Brown (1975).

The differences in population structure between *Tellina mariae* and *Katelysia rhytiphora,* plus the fact that P:B ratios in the literature tend to be higher for tellinid than for venerid bivalves, suggest that the two species have different life history strategies.

Tellina produces abundant young which have a high mortality rate, while *Katelysia* is a species in which the relatively few young that are produced have a high survival rate. There is also some morphological evidence to support this interpretation of the life histories of the two species. The shell of *K. rhytiphora* is thicker than that of *T. mariae* and has obvious concentric ridges, features which may be interpreted as conferring protection against predators. In contrast, *T. mariae* has no obvious morphological features which would give protection against predators, and Vermeij (1978) remarks of the Tellinidae that they may best be regarded as " .... weeds, which survive the depredations of their enemies by high reproductive rates."

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